

KTP Biochar - Finland

IN-Helsinki

Anna Salmensaari

3.3.2020

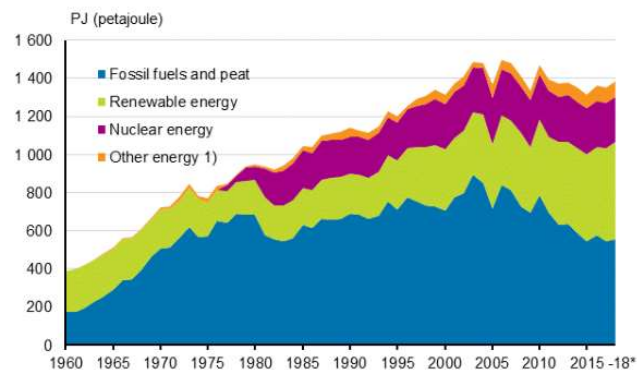
VISIT...

LANZAROTE
Caliente.COM

Finland

- Total energy consumption fell by 7 % during the first half of 2019
- Carbon dioxide emissions from the energy use of fuels declined by 12 %
- The consumption of renewable wood fuels decreased by 10 %.

Total energy consumption



1) Incl. reaction heat from industrial processes, hydrogen and net imports of electricity

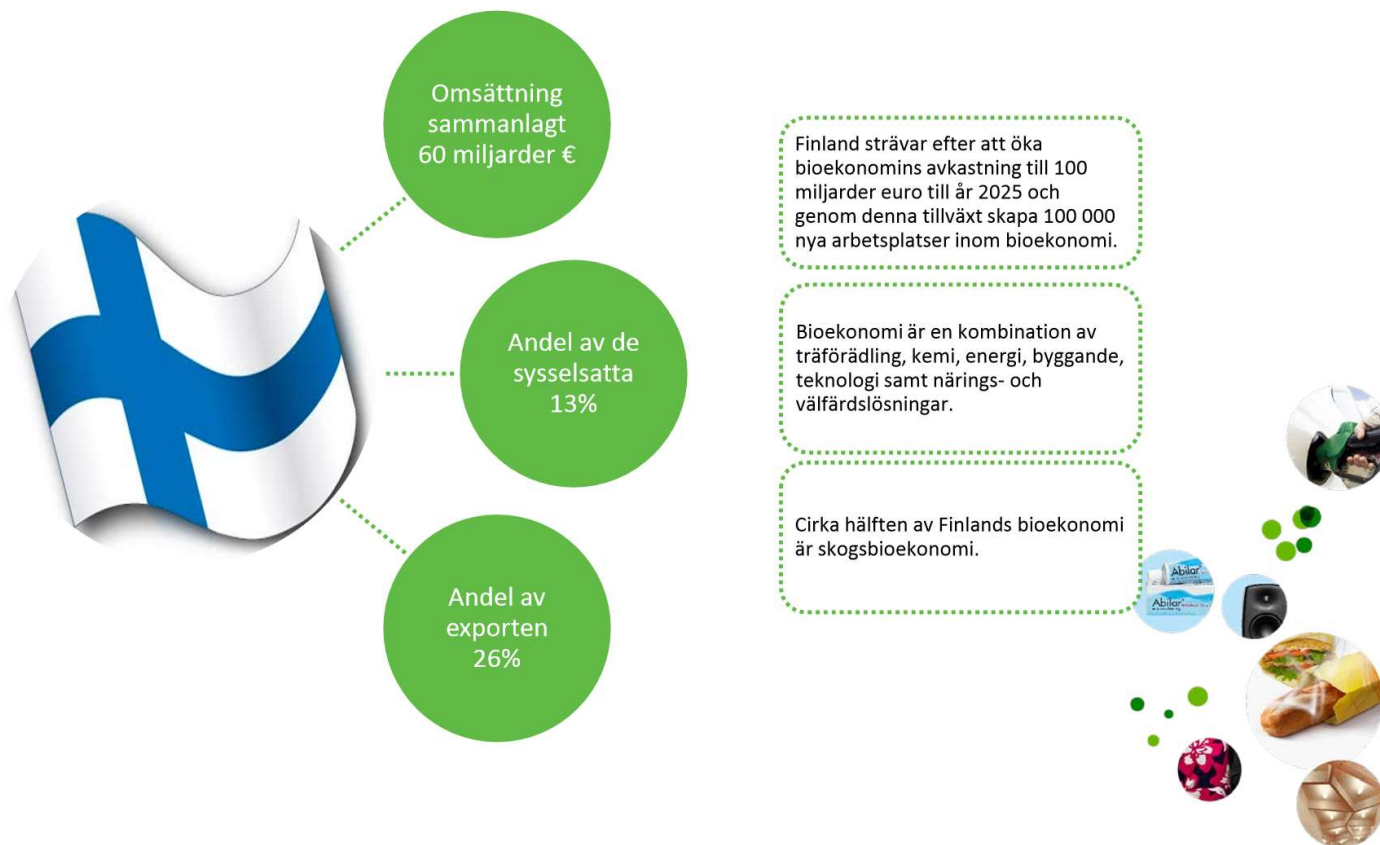
* preliminary data

Source: Statistics Finland, Energy supply and consumption

Finland

Population 2018	5.517.919
GDP per capita	42.504
Total energy consumption (PJ)	1.3830
Area, m ²	338.145
Of which forest	75 %

Bioekonomins betydelse för Finland



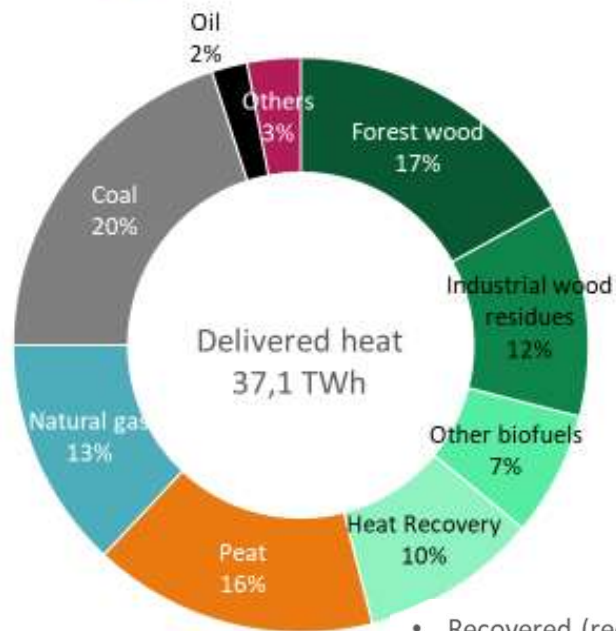
No governmental incentives for biochar - yet



- So far there are no incentives or regulations concerning biochar
- The Finnish climate panel mentions biochar as a means to compensate for the emissions.



Energy sources for district heat supply 2018



Delivered heat
37,1 TWh

CO₂-neutral 46%

- Forest fuelwood, industrial wood residue, other biofuels, recovered heat

Renewable 36%

- Forest fuelwood, industrial wood residue, other biofuels

Domestic 64%

- Forest fuelwood, industrial wood residue, other biofuels, recycled heat, peat
- Recovered (recycled) heat: energy that would otherwise go to waste
- Other biofuels: includes also the bio share of municipal waste
- Other: non-bio share of municipal waste, plastic or hazardous waste, electricity.

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Finnish Energy

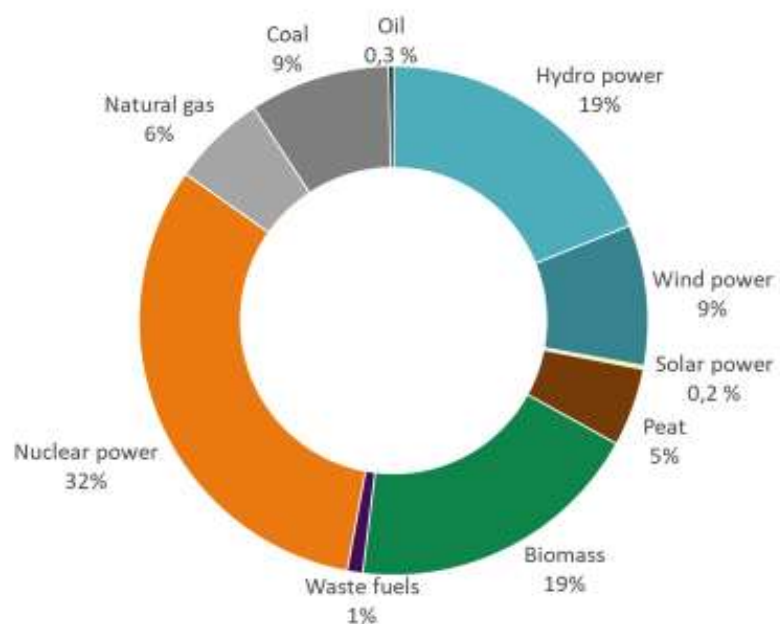


Innovation
Norway

16.1.2019

Electricity Generation by Energy Source 2018

67 TWh



Renewables: 47 %

Carbon dioxide free: 79 %

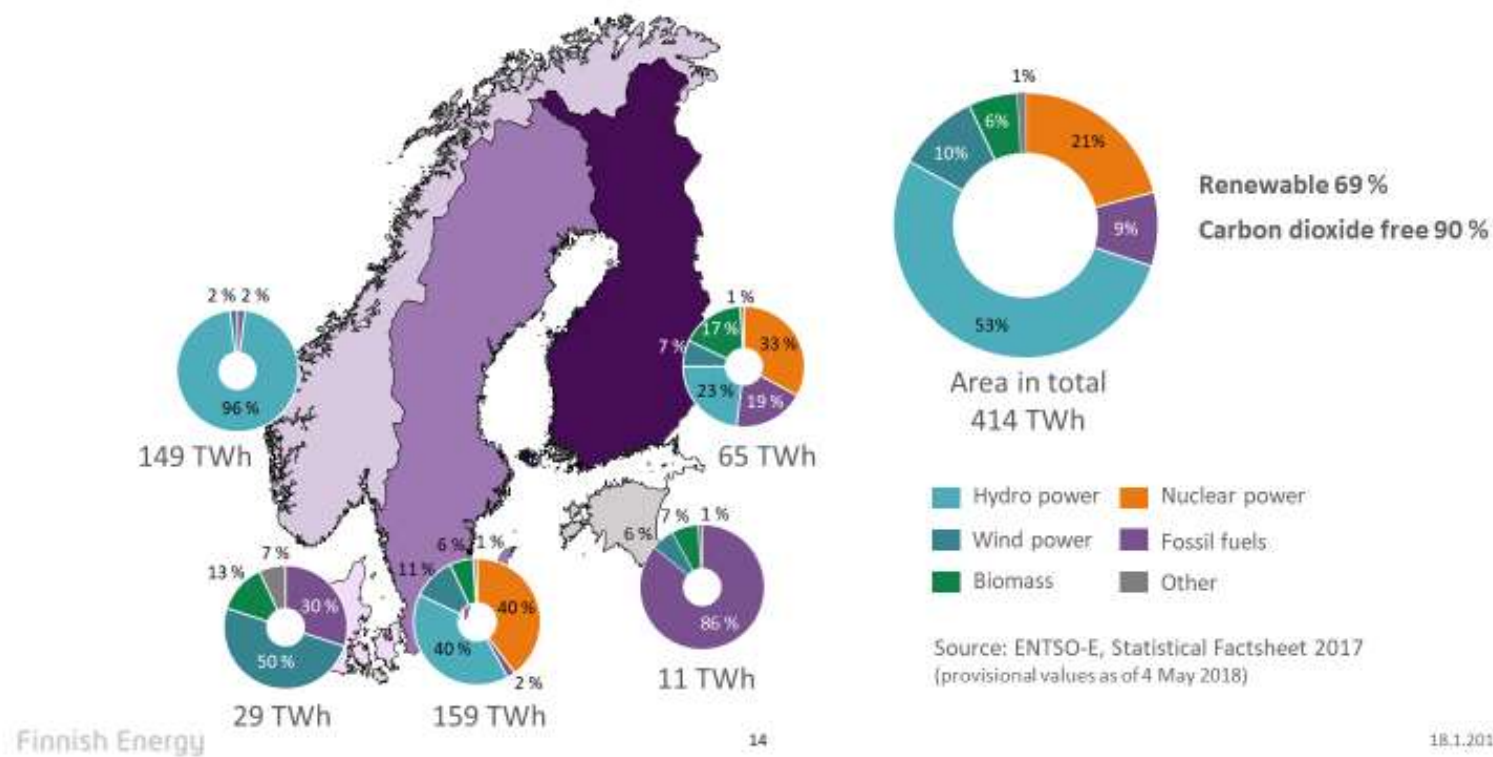
Domestic: 53 %

Finnish Energy

12

18.1.2019

Electricity generation in Nordic market area 2017



Demand exceeds supply

- As of today, there is an excess demand over supply of biochar. Finland is a forerunner within production of biochar. Biochar is bought from Finland, mainly from Carbofex.
- Biochar is used mainly in agriculture and tree planting and planting of green areas in cities. Forerunner within urban planting is Stockholm. Other cities in the Nordics are far behind.
- Distribution of biochar through players abroad



Biochar players

The Finnish biochar industry

Technology	Consulting, plant construction	Biochar production by source	Wholesale	Maintenance	Further processing, gardening
Carbofex	Carbofex	<i>Norwegian spruce:</i>	Carbons Fi	Ecomation	Biolan
Ecomation	Ecomation	Carbofex	Noireco		Kekkilä
	Noireco	<i>Willow:</i> Carbons Fi			
		<i>Birch:</i> Charcoal Fi			
		<i>Peat:</i> Vapo Carbons			

Source: company webpages, Business Finland

Technology

Carbofex Oy

- Est. 2016
- Turnover 200.000 Eur
- Nr of employees 5
- Solutions
 - Manufacture of special-purpose machinery
 - Biochar pyrolysis technology
 - Biochar products,
 - Energy

An integrated Carbofex Pyrolysis facility yields

- 25-30% of biochar (50% of the total energy),
- 12% pyrolysis oil (25% of total energy),
- 20% pyrolysis gas (20 of total energy),
- 0-50% will be usable as heating energy.

Technology cont.

Ecomation Oy

- Est. 2007
- Turnover 1,5 mill Eur
- Solutions
 - Town and city planning
 - Technology
 - Pyrolysis based solutions
 - Scrap processing lines & equipment for the recycling industry
 - Waste-to-energy solutions
 - Maintenance
 - Advisory services
 - Turnkey solutions

www.ecomation.com

Noireco Oy (former BioCore Oy)

- Est. 2016
- Turnover n.a.
- Solutions
 - Landscaping
 - Soil improvement
 - Filtering
 - Seedbed
- www.noireco.fi

Biochar production by source

Source	Company
Norwegian spruce	Carbofex
Willow	Carbons Finland
Birch	Charcoal Fi
Peat	Vapo Carbons

Biochar production by source

Carbons Finland Oy

- Est. 2014
- Turnover 124.000 Eur
- Nr of employees 2
- Wholesale
- Specialized in **willow**
- Biochar solutions for
 - Treatment of stormwater and runoff waters
 - Landscaping and restoration of vegetation
 - Composting & nutrient recycling
 - Efficient organic farming

Charcoal Finland Oy

- Est. 1999
- Turnover 75.000 EUR
- Production of products from **birch**
- Production of char from birch for
 - Soil improvement
 - Composting and covering

Vapo Carbons Oy

- Part of Vapo Oy (supplier of biofuel from peat and wood)
- Peat-based activated carbon portfolio

Gardening

Biolan Oy

- Est. 1974
- Turnover 35 million Eur
- Nr of employees 122
- Main line of business: Manufacture of fertilisers and nitrogen compounds
- Compounds of soil and biochar
- Composting
- Water purification

Kekkilä Oy

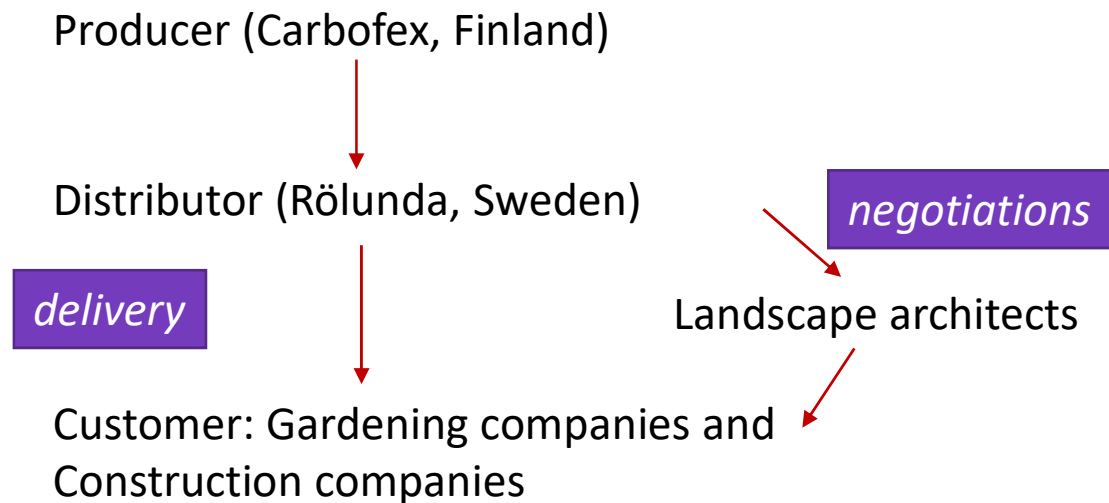
- Est. 1984
- Turnover 62,2 million Eur
- Nr of employees 129
- Producer, wholeseller, reseller, agent, importer within
 - Soil
 - Peat products
 - Fertilizers
 - Soil covering materials

Biochar companies

Company	Description	Raw materials	Web page
BIOLAN	Manufactures biochar in subsidiary in Estonia and uses biochar for consumer products. The planting soil containing biochar was the "Garden product" of 2018		www.biolan.fi
CARBOFEX	Biochar producer, retailer and whole seller. The plant is the biggest continuous pyrolysis facility in Europe. The Largest EBC-certified producer in Europe and the only one in the Nordics Produces CO2 negative district heat for around 30 multi-storey buildings in Tampere.	PEFC-certified spruce and birch	www.carbofex.fi
CARBONS FINLAND	Refines biochar produced by subcontractors according to customer needs. Plans to start own biochar production. Provides biochar solutions for the treatment of stormwater, seepage water and runoff waters, landscaping and restoration of vegetation, composting and nutrient recycling and efficient organic farming	PEFC-certified fiber	www.carbons.fi
CHARCOAL FINLAND		Birch	www.charcoalfinland.fi
NOIRECO	Tailor-made biochar solutions for landscaping, soil improvement, filtering, green building and nutrient recycling.	- Spruce and birch fibre - Industrial side streams	https://noireco.fi/
ECOMATION	technological solutions based on pyrolysis. The company has developed technology which is capable of producing biochar from various organic materials, including waste, side streams and sewage sludge. The company is co-operating with various parties, including Gasum, HSY and Luke.		www.ecomation.com/
Carbo Culture	Technology	Waste	www.carboculture.com
Vapo	The first carbon production facility will be completed in 2020 in Ilomantsi. Activated carbon is needed in industrial processes and food production to absorb chemicals, metals and odours. Areas of application: car cabin air filters, extractor hoods, water filters and vacuum cleaners.	Peat	www.vapocarbons.com/

Biochar distribution channels

- The agreement between landscape architects and construction companies says that the construction companies have to use charcoal in their building project.



Example: City of Stockholm

Resellers / retailers of biochar in Finland

- Alku & Juuri physical store <https://hyotykasviyhdistys.fi/alku-ja-juuri/>
- Hyötykasviyhdistys, useful plants association, <https://hyotykasviyhdistys.fi>
- Viidakkotohtori webstore www.viidakkotohtori.fi/se
- Chilitarvike webstore www.chilitarvike.fi
- Pavunvarsi webstore www.pavunvarsi.fi
- Siemenkauppa webstore www.siemenkauppa.com
- Carbons Finland webstore www.carbons.fi

Areas of use

SITRA

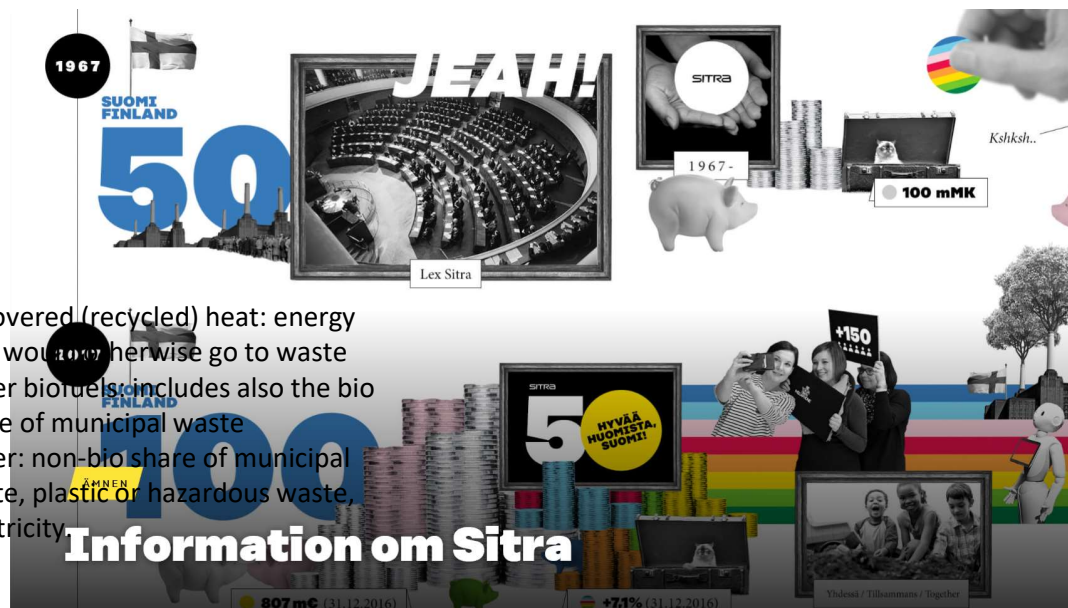
Sitra är finländarnas framtidshus vars mål är en rejäl och hållbar framtid – välfärdens nästa rond – och ett bra liv inom gränserna för jordens bärkraft.

Sitras uppgift är att utveckla välfärden och konkurrenskraften i Finland.

Politiskt och ekonomiskt oberoende jubileumsfond



www.sitra.fi



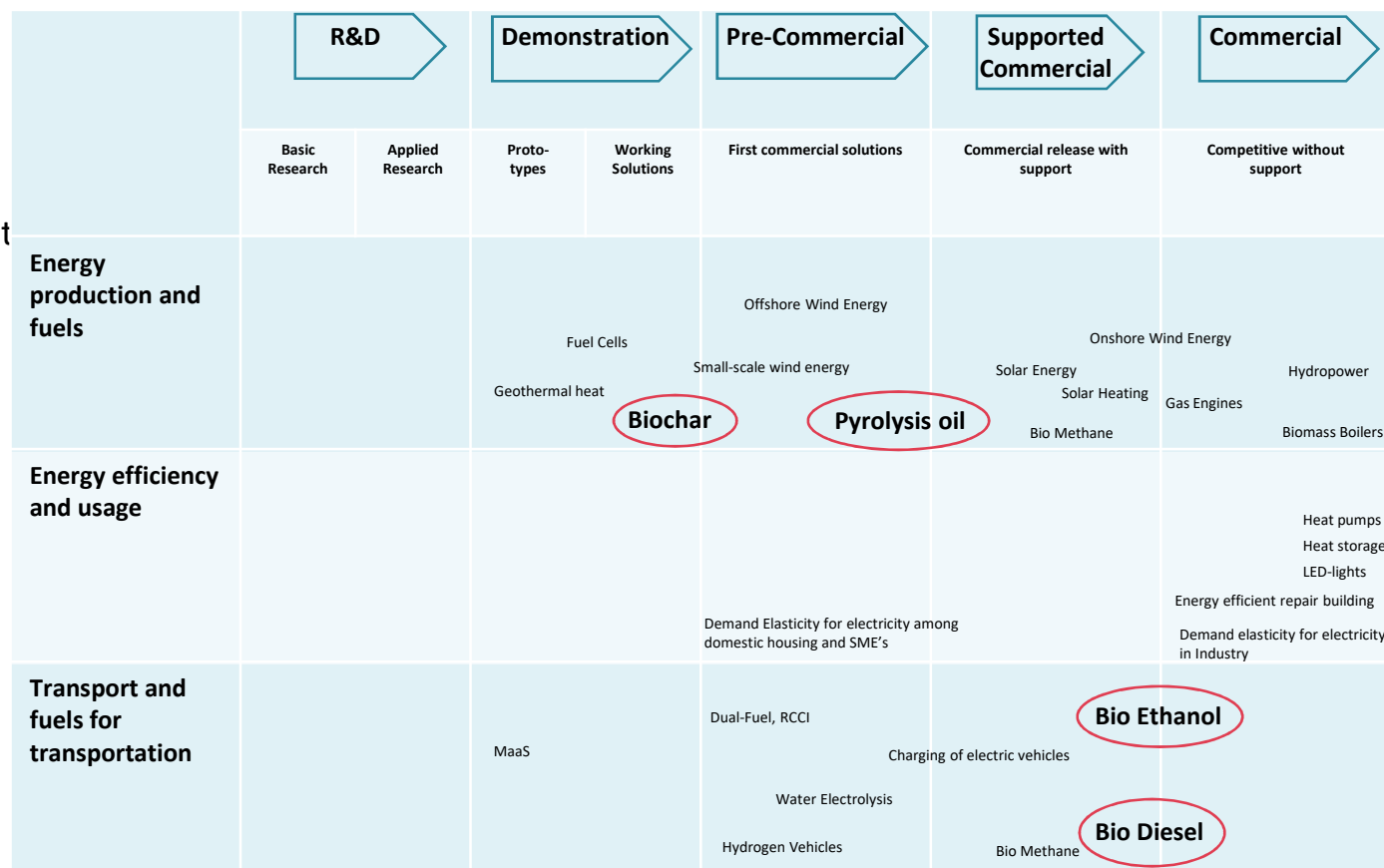
Teman:

- Förnyelseförmåga,
- Kolneutral cirkulärekonomi
- Nytt arbetsliv och Hållbar ekonomi

Bioethanol and biodiesel in the commercialization phase

These are the most important technologies within

1. energy production & consumption,
2. energy efficiency, and
3. traffic



Övergången till biobränslen förbättrar bytesbalansen och skapar sysselsättning

Användningen av cleantech-lösningar inom energisektorn

- förbättrar bytesbalansen
- bidrar till fler arbetsplatser samt
- minskar på utsläppen

Exempel

- övergången från fossila bränslen till biobränslen förbättrar avsevärt bytesbalansen.
- Förädlingskedjan inom biobränslen sysselsätter mest.
- De mest märkbara minskningarna i utsläpp kommer från biobränsle, vindkraft, samt elbilar.

Opportunities in Finland within biochar

- Carbofex and Tampere electric utility have agreed to build a large combined biochar / peak district heating station with total value of 20 million euros.
 - The unit will initially produce 60.000 m³ of biochar and have a peak heating capacity of 30 MW. Project start is scheduled for mid 2021.
 - The project will be one of the first industrial scale biochar production schemes, with reservations to expand to 240.000 m³ / year and 120 MW.

Trends within biochar

- Trade with willow
- Carbon drawdown
- Cities

Biofuels for energy production

	Lower emissions		Impact on employment		Impact on current accounts		Phase
	tCO ₂ /year	tCO ₂ /GWh produced	many year	Many year / GWh produced	Mill € / year	1000€ / GWh produced	C = Commercial P = Pre-commercial R&D-phase
Biochar	288 456	336	1 951	0,2	68	8	R&D
Pyrolysis oil	788 400	263	883	0,3	156	52	P
Biometan	990 720	180	3 266	0,6	205	37	C

- Production of biofuels and turning it into energy is essential in order to lower emissions.
- Solutions that replace imported fossil fuel are of great interest to the Finnish economy.

Use of biochar in Finland

Biochar can be added to livestock feed to improve well-being. The same biochar moves to manure where it reduces odor and continues to compost, improving the composting process. In the end, biochar contained compost can be used in soil to improve growth.



Biochar focus areas in Finland

- Agriculture & soil improvement
- Filtration
- Cities
- Production of biochar
- Technology development

Agriculture

- Improves the soil quality
- Captures and keeps nutrients in the soil
- Recommended to mix with fertilizer; easier to spread onto soil
- Only little experience so far
 - Still in test phase
 - Too expensive
 - Prejudice
 - Not enough knowledge about positive effects and efficiency
- Biofilter field drainage give positive test results in Nystad (Western Finland).
- Note: biochar not to be used as powder but the size of small stones

In Finland, biochar rather to be used as filter instead of cultivating purposes. Larger benefits from cultivating in dry soil.

Cities

- Turku (sv. Åbo) nr 1 in Finland within use of biochar in cities
- In most cities
 - Small projects
 - Conducted in 2017 - 2019
- Positive mindset towards biochar
- Use within
 - Planting of trees in cities
 - Drainage water
- Expectations that projects will grow in number and size



Source: Turkulainen

Biogas & composting

- Composting
 - By adding biochar,
- Improving the soil quality
- Capture and keep nutrients in the soil
- Players
 - Biolan Oy www.biolan.com
 - Kekkilä www.kekkila.fi
 - Viherrinki www.viherrinki.fi
 - Viherlassila www.viherlassila.fi
- Research
 - LUKE www.luke.fi
 - Universities of Helsinki and Jyväskylä, Faculty of biological and environmental sciences
 - University of Eastern Finland

Biolan

- Composters, soil with biochar
- Professionals farming:
 - Growing mediums, organic fertilisers, greenhouse technology

Kekkilä

Composters, soil, fertilisers, gardening products, dry toilets



Innovation
Norway

Sources: company webpages, www.ytj.fi; www.kauppalehti.fi

Filtration

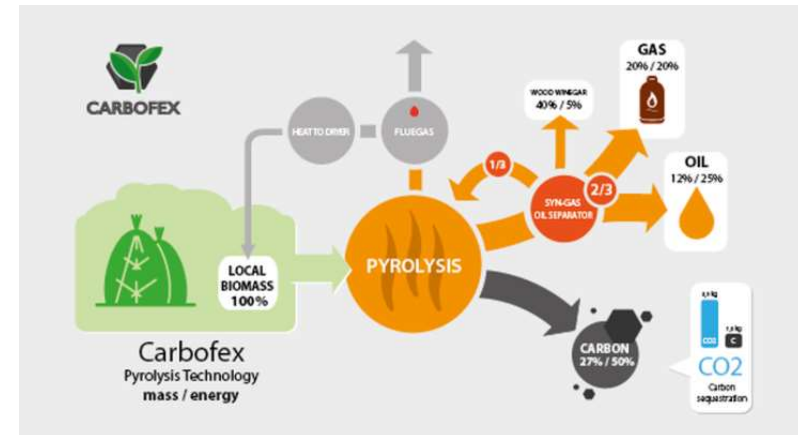
- Used in cities and agriculture
 - Cities: urban runoff water
 - Eg. Turku / Åbo, Nystad, St. Mickel
- Water purification
- Players:
 - Carbons Finland Oy
 - Noireco Oy



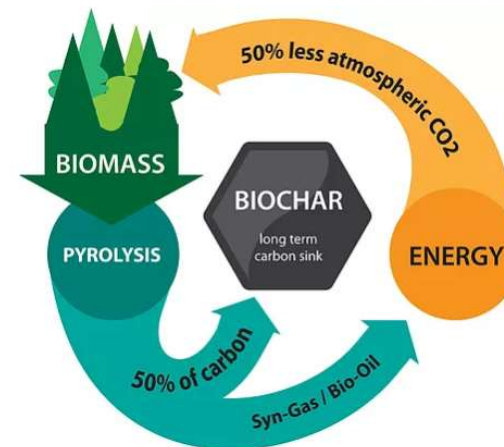
Source: Carbons.fi

Carbon capture

- Willow-based biochar (Carbons.fi) acts as carbon sink
 - Has an excellent pore structure
 - Binds water and dissolved nutrients
- Carbofex: With pyrolysis technology raw material carbonizes purely and emissions are down to CO 0-5 ppm, NOx <60 ppm, O2 e-5%



Source: www.carbofex.fi



2500 ton annual CO₂/carbon sequestration

For every 1 kg biochar produced the Carbofe plant captures 3,5 kg of atmospheric CO₂ into long-term storage in the ground.

Use of biochar in buildings – not yet in Finland

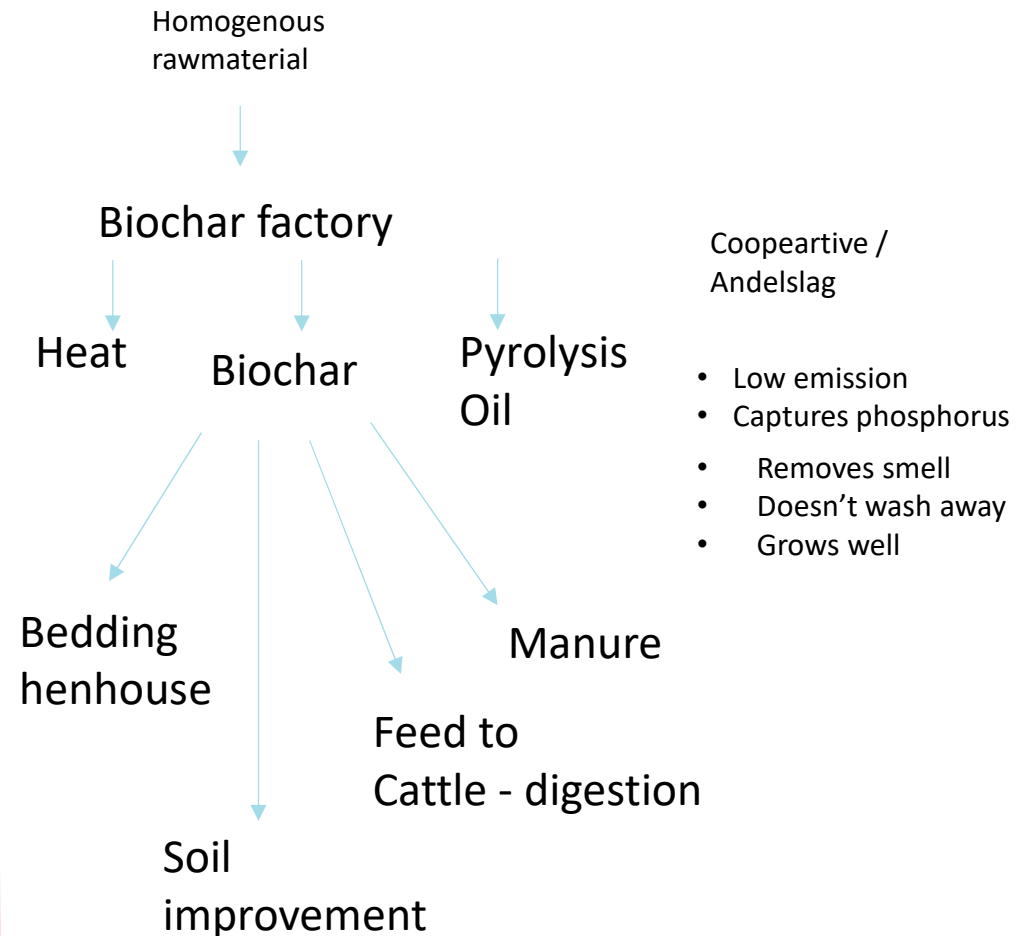
- Biochar can be used in buildings
- Improves the room climate
- The best insulator, since it contains air
- Noise protection
- Can replace sand. Provides light bricks

To be mixed with clay to avoid risk of fire

Biochar in buildings still needs research
In the Nordics, pressure will be on the construction industry

Added value in Norway from cascade chain reactions within 3 years

- Invest in biochar production factory
 - Use homogenous raw material
 - Investment support available?
 - Norway can become a big player
 - Make sure that there is demand for the biochar both in Norway and abroad
- Areas of use within
 - Fishfarming
 - Agriculture
 - Urban horticulture
 - Building industry



Research

Biochar

Organizations

- The Finnish Biochar Association,
www.suomenbiohiili.fi

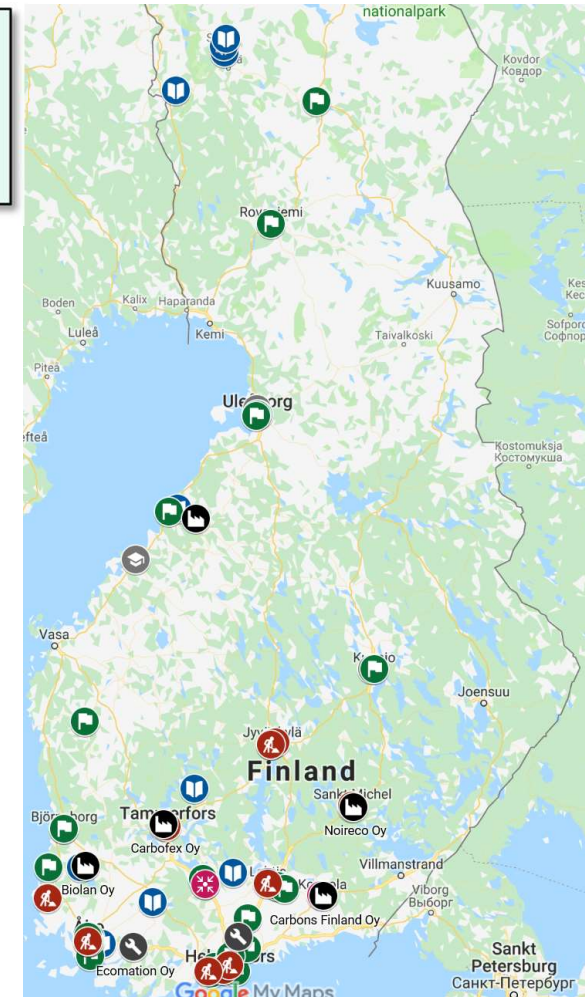
Universities & research organizations

- Natural Resource Institute LUKE
- Häme University of Applied Science
- South Eastern Finland University of Applied Science
- University of Eastern Finland, Kuopio
- University of Helsinki
- University of Jyväskylä
- University of Oulu
- VTT Technical Research Center
- Kokkola University Consortium Chydenius



“Biochar is a heterogeneous substance rich in aromatic carbon and minerals. It is produced by pyrolysis of sustainably obtained biomass under controlled conditions with clean technology and is used for any purpose that does not involve its rapid mineralisation to CO₂ and may eventually become a soil amendment.”

Source: <https://www.suomenbiohiili.fi/en/biochar-map/>



Research organizations and links

Organization	Research group	Description	Link
University of Helsinki	AgriChar research group	Focusing mainly on the effects of biochar systems on the physico-chemical properties of soil, on soil biota and on the yield formation and nutrition of field crops.	http://biochar-hy.blogspot.com/p/university-of-helsinki-biochar-team.html
University of Helsinki	Urban ecosystem services	Assess the role of urban vegetation/trees and soils in purifying air and urban runoff water, as well as their ability to store carbon and nutrients in the system.	https://researchportal.helsinki.fi/en/projects/ecosystem-services-to-cities-ekosysteemipalveluja-kaupunkiin-vih
Natural Resources Institute Finland		Promote bioeconomy and sustainable use of natural resources.	https://www.luke.fi/en/
Natural Resources Institute Finland	Mobile Flip	Develop and demonstrate mobile processes for the treatment of underexploited agro- and forest based biomass resources into products and intermediates.	http://www.mobileflip.eu/index.htm
Häme University of Applied Sciences	BioKierto	Developing a geographical circular model	https://www.hamk.fi/projektit/biokierto/?cn-reloaded=1 https://blog.hamk.fi/biokierto/

Natural Resource Institute LUKE

Promoting bioeconomy and sustainable use of natural resources

- Knowhow on use of biochar in agriculture
 - Biochar in agriculture still on R&D level
 - Biochar in urban areas has developed much more
 - Contact person Kristiina Regina, tel. +358 295326474
- MobileFlip: Develop and demonstrate mobile processes for the treatment of underexploited agro- and forest based biomass resources into products and intermediates.
- Mine waste areas: Utilization of biochar in dry cover material and landscaping of mine waste areas; June 1, 2017 – May 31, 2020. In cooperation with GTK and University of Oulu.
 - Contact person Mr Kari Mäkitalo, +358295324465

Research at universities of Applied Science

Häme University of Applied Science HAMK Bio- Sustainable Bio-economy

- Research on how biochar and other filter material can be used for water cleaning
<https://www.hamk.fi/tutkimus/vesitalous/>
- Contact person Annukka Pakarinen, +358 50 300 1827.

South Eastern Finland University of Applied Science XAMK Forest, the Environment and Energy dept.

1. Material technology testing for technology and construction industry purposes. Within circular economy development activities, the focus is on biomaterials (side streams of the forest industry and agriculture) as well as in the applications of circular economy in the construction industry and development of knowhow.
 2. Research on Biochar and bio fly ash micronization and material applications - bio fly ash from power plants is micronized and the utilization possibilities of micronized bio fly ash in concrete are studied. Project duration is 1.8.2018–31.12.2020. <https://www.xamk.fi/en/research-and-development/biochar-and-bio-fly-ash-micronization-and-material-applications-in-kymenlaakso-region/>
 3. RDI Flagship spear project on Forest industry residuals to value – Biochar for clean bio- and circular economy. In cooperation with LUKE. <https://www.xamk.fi/tutkimus-ja-kehitys/biotuotteet-ja-puhdas-biotalous-ti-karkihanke/>
- Contact person Research Director Lasse Pulkkinen, +358 44 571 5861, lasse.pulkkinen@xamk.fi

University research

University of Kuopio

- 1) the synthesis of biochar from different biowastes
 - 2) different modification routes for biochar preparation (to increase its potential for different applications)
 - 3) synthesis of biochar (nano)composites
 - 4) application of biochar in water treatment (especially removal of metals and emerging contaminants, e.g. pharmaceuticals)
 - 5) application of biochar for CO₂ capture (research will be started in next few months)
- Contact person Amit Bhatnagar, +358 50 300 1827.
- 6) biochar as a tool for soil quality
- Contact person Ph.D. Jukka Pumpanen, +358 50 448 6127

University research cont.

University of Helsinki

AgriChar research group – towards a carbon-negative agriculture

- Study the functioning of biochars in soil and environment and its role for plants
- Main focus on the effects of biochar systems on the physico-chemical properties of soil, on soil biota and on the yield formation and nutrition of field crops.
- In cooperation with LUKE
- Contact person Dr. Priit Tammeorg, priit.tammeorg@helsinki.fi
- <https://biochar-hy.blogspot.com/p/university-of-helsinki-biochar-team.html>

University of Oulu

Geoscience research group, Oulu mining school

- Utilization of biochar as a cover material in mine waste areas; in cooperation with LUKE
- Contact person Santeri Kaisanlahti, +358 50 302 8738
- <https://www.oulu.fi/oms/>

University research cont

Kokkola University Consortium Chydenius

- acts as a joint institution in Kokkola, carrying out teaching and research under the auspices of the universities of Jyväskylä, Oulu and Vaasa
- areas of specialization mainly reflect those of its university partners: education, data processing, social sciences and regional studies, business and administration, natural sciences, and materials technology.

Research: Activation of biochar into highly porous activated carbon, Sept 2017

- effects of different chemical and physical activation agent, on the specific surface areas, pore volumes, pore size distribution and total carbon content of biochar, produced from lignin.

VTT - TECHNICAL RESEARCH CENTRE OF FINLAND LTD

- part of Finland's innovation system and operates under the mandate of the Ministry of Employment and the Economy.
- a visionary research, development and innovation partner

Some of the focus areas

- bioeconomy and circular economy
- Low carbon energy

Research related to biochar:

Replacing coal used in steelmaking with biocarbon, 2019, Juha Hakala

Impact of Biochar on Treatment Performance of Roadside Sand Filters: Field Monitoring and Geochemical Modelling, 2018, Eero Assmuth

Events

Events 2019

- **3.-5.6** World Circular Economy Forum, Helsinki
<https://www.sitra.fi/en/projects/world-circular-economy-forum-2019/>
- **9.-10.7** European Bioeconomy Scene 2019, Helsinki
<https://www.bioeconomy.fi/eubioscene19/>
- **11.-13.9** World BioEconomy Forum, Ruka
<http://www.wcbef.com/speakers/>
- **4.-6. 9** Biochar Study Tour Finland (Helsinki & Tampere)
Program (Finnish): <https://www.suomenbiohiili.fi/tulevia-tapahtumia/ibi/>, (English): <https://biochar-international.org/event/ibi-biochar-study-tour-finland/>
- **30.9 – 1.10:** The Finnish Presidency Event: European Days for Sustainable Circular Economy, Helsinki,
<https://edsce19.eu/#programme>

Cont. Events 2020

- Agricultural and Food science days 8-9.1.2020.
<http://www.smts.fi/fi/node/241>
- Biopeitto workshop (mining) 20.1.2020, 10:00–16:00 in Rovaniemi
- 11.2.2020 Biochar pre-seminar at Viherpäivät in Jyväskylä (only in Finnish)
<https://www.vyl.fi/viherpaivat/kavijoille/seminaarit/pre-seminaarit-2020/>
- Biochar quality day 17.3.2020, Tampere
 - About quality, supply and use of biochar
- Biohiiltä Pirkanmaalle (=biochar to the Pirkanmaa region), 2.4.2020
 - Target group: municipality decision makers within landscaping and procurement (only in Finnish)
<http://biobisnesta.fi/ajankohtaista/>

For more information about upcoming events in Finland, please contact Esko Salo, Finnish Biochar association esko.salo@suomenbiohiili.fi

Biochar links

<https://www.suomenbiohiili.fi/en/biochar/>

<https://carbons.fi/biohiili/>

<https://www.biochar-journal.org/en/ct/2-The-55-uses-of-biochar>



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Tusen takk!

www.innovasjon norge.no